

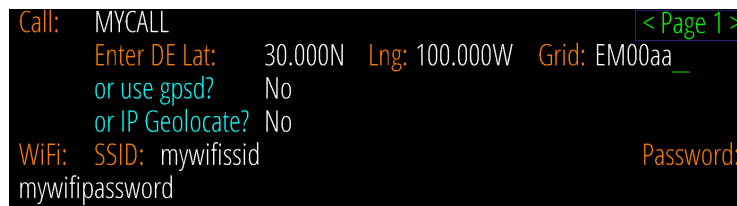
HamClock 4.03 User Guide

This document and additional supporting material may be found at <https://clearskyinstitute.com/ham/HamClock>.

Welcome to HamClock. When first started, you may enter the Setup system. Setup is required if any entries are missing or invalid.

Setup provides several pages of configuration options. The exact choices available will depend on your platform but all options are shown below for completeness. **Orange** text denotes passive prompts for the corresponding **White** data fields to their right. **Cyan** text denotes on/off choices or other discrete options. Tapping on a data entry field will place a green cursor where the next character will go. Tap **Delete** to erase the character to the left. Tap the **Page** arrows to move to next or previous. When finished, tap **Done**. If any fields do not pass basic checks, they are marked with a red **Err** and you remain on the Setup screen until corrected.

Pages with text fields include a virtual keyboard for use on touch screens or with a mouse. On desktop systems, a normal keyboard may also be used using *tab* to step to the next prompt; *delete* to erase a character, *space* to toggle discrete options; *arrow* keys to edit; *escape* to change page and *Return* for Done.



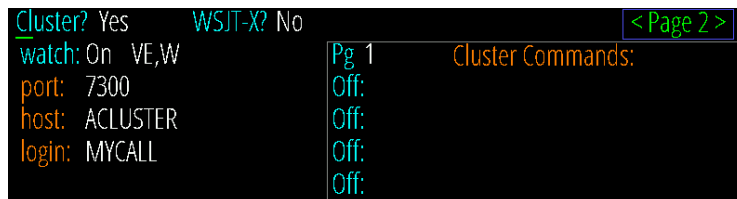
Call: enter your call sign, up to 11 characters.

DE Lat, Long, Grid: these fields are your station location. You may enter a grid or enter \pm degrees or use N/S suffix with Lat and E/W with Lng. These fields disappear if *gpsd* or *IP Geolocate* are active. May also be changed from the main HamClock screen by tapping the DE lat or long or grid value.

use *gpsd*? Allows connecting to a *gpsd* daemon on your local network for DE location and time. Enter the host name of your *gpsd* server; the port is fixed to 2947. When used, *gpsd* is used to set location once and update time continuously, or you may also choose to follow your location once per minute.

IP Geolocate? If Yes, uses your public IP to set Lat and Long, and removes those prompts. This may not be accurate so always double-check the results.

WiFi? This toggles whether to set WiFi credentials, if possible on a given platform. If/when active, type the SSID network name and password in the given fields. On RPi, *activate this only if you want to make a change*; leave off otherwise. Note this only refers to login credentials, whether wifi is actually used is managed by the host system.



Cluster? This section controls DX Cluster or WSJT-X spotting. For a cluster enter its internet **host** name and **port**. The **login** must contain at least your call from Page 1; add an SSID suffix if connecting to the same cluster from more than one program simultaneously. For WSJT-X enter the IP of the computer running *wsjtx* and its UDP Server port number. See page 10 for additional information.

Cluster Commands can be entered in the table. Those marked **On** will be sent once to the cluster server right after logging in. These must be in the native cluster syntax, HamClock does not check them. Click **Pg** for more entry lines.

watch? contains prefixes or calls separated by blanks or commas. When set to **On** then all spots will be listed in the DX Cluster pane with any matching spots highlighted in red; when **Off** the watch entry is ignored; when set to **Only** then only spots matching the watch list will be shown in the DX Cluster pane.

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Setup pages, continued

```
rigctld? Yes port: 4532 host: localhost < Page 3 >
rotctld? Yes port: 4533 host: localhost
flrig? Yes port: 1234 host: localhost
NTP? Use default set of servers
ADIF? file: ~/Desktop/log.adif
S/P/A watch: Only W N A
```

rigctld? rotctld? Whether and how to connect to **hamlib** for radio and/or rotator control. See pages 8 and 10.

flrig? Whether and how to connect to w1hkj's **flrig** for rig control. See page 10.

NTP? Set the name or IP of one NTP server of your choice; or set to **OS** to use the host computer time; else use the list of built-in default servers.

ADIF? Set file used by the ADIF pane; may include environment variables and ~. See page 9.

S/P/A watch? prefixes of interest for SOTA, POTA and ADIF panes, similar to DX Cluster watch; see page 1.

```
Map center lng: 90W < Page 4 >
GPIO? Active I2C file? name: /dev/cu.usbserial-DB00PFLT
BME280@76 dTemp: 0.00 dPres: 0.000
BME280@77 dTemp: 0.00 dPres: 0.000
KX3? 4800 bps
Brightness Min%: 0 Max%: 100
```

Map center lng: set desired center map longitude for the Mercator and Robinson projections. Can be further adjusted by tapping the map at the desired longitude and selecting Center.

GPIO? Controls whether the native RPi GPIO pins will be used by HamClock. See page 15.

I2C file? Host system name for the I2C bus connection, either native or via USB. See page 15.

dTemp, dPres: temperature and pressure corrections added to each BME280 sensor, if installed. See page 14.

KX3? Toggle direct KX3 frequency control Off or set serial baud rate. See page 14.

Bright Min% and **Max%:** display brightness range, if supported, as percent of hardware total.

```
Date order? Mon Day Year Log usage? Opt-In < Page 5 >
Week starts? Sunday Demo mode? No
Units? Imperial Bearings? True N
Rank SpcWx? Yes New Wx? Yes
Spot labels? Prefix Spot paths? Wide
Scroll direction? Bottom-Up Scroll length? 10
Pane rotation? 5 seconds Show public IP? Yes
Full scrn web? Yes Full scrn direct? No
```

Date order? choose one of three formats for all date displays.

Log usage? choose whether to send us your HamClock settings *anonymously* to guide further development.

Week starts? choose whether the first calendar column is *Sunday* or *Monday*.

Demo mode? *Yes* causes HamClock to change its own settings automatically. See page 12.

Units? choose *Imperial* or *Metric* units for environment sensor, weather data and distances.

Bearings? choose *True* or *Magnetic North* when displaying bearings to DX.

Rank SpcWx? whether the upper-right SpcWx pane entries are sorted by greatest impact.

New Wx? whether to temporarily show weather when setting new DX or DE.

Spot labels and paths? whether and how to label and draw Live, POTA, SOTA and DX Cluster calls and paths.

Scroll direction? whether scrolling panes fill from *bottom-up* or *top-down*.

Scroll length? number of additional scrolled lines beyond what is visible

Pane rotation? select one of several pane rotation periods.

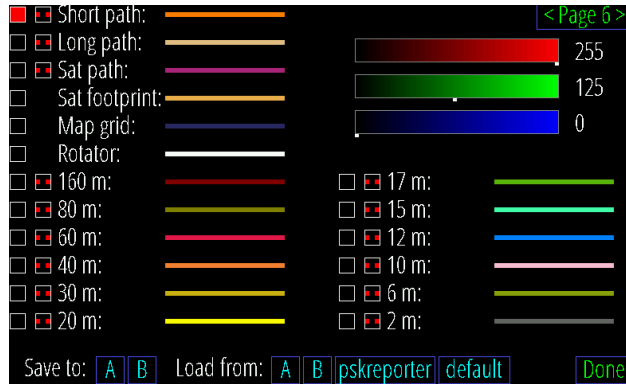
Show public IP? whether the main page shows the public network address (local address is always shown)

Full scrn web? set to *Yes* to enable full screen option on Live web connections.

Full scrn direct? set to *Yes* to force HamClock to fill all surrounding screen area with black, when possible.

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Setup pages, continued



Map Colors: This page controls the colors used for map paths and band indications. To edit, select a color then tap within the color bars or tap just above or below the numeric values to change them by ± 1 . The dotted box selects whether map paths are drawn dashed or solid. Two palettes may be saved and loaded later as well as two handy defaults.

DE Daily Display On/Off Times							
	< Sun >	< Mon >	< Tue >	< Wed >	< Thu >	< Fri >	< Sat >
On	08:00	06:00	06:00	06:00	06:00	06:00	08:00
Off	22:00	23:00	23:00	23:00	23:00	23:00	22:00

On/Off Times: Use this table to set desired DE on and off (or dim) times for each week day. Tap just above or below each number to increase or decrease. Left and Right arrows copy to the adjacent day. The On/Off pane will also display, and allowed editing, the current day settings (only) (see page 5). The display is never turned off if both times are equal. Available only when using full screen and on certain platforms.

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Tap to cycle Call sign background
 Tap to cycle Call sign foreground
 Shows a big ? if time is not syncing
 Current version. Red when old. Tap to update.
 Tap to sync to UTC; red OFF if not
 Tap to set lock, set demo, exit, restart, send diagnostics
 Indicates this is read-only live web
 Tap for Stopwatch, count down timer and Big Clock
 Up time; Local and Public IP; WiFi RSSI. red if RSSI < -75 dBm, tap for meter
 Tap to shift time forward or back
 Tap to change time units

Map style -- see page 12
 Roving cursor info, see page 12
 Long path
 Short path
 DE
 Sun
 Rotating RSS feeds
 Sub-earth Moon location and phase from surface
 NCDXF beacon
 DX
 eHam: My End Fed Stealth Antenna

Mercator projection centered at 0° longitude -- tap anywhere to set DE, DX, pan or zoom, see page 10

Terrain
 style:
 ○ Countries
 ○ Terrain
 ○ DRAP
 ○ MUF - VOACAP
 ● MUF - RT
 ○ Aurora
 ○ Weather
 grid:
 ● None
 ○ Tropics
 ○ Lat/Long
 ○ Maidenhead
 ○ Azimuthal
 ○ CQ Zones
 ○ ITU Zones
 Projection:
 ● Mercator
 ○ Azimuthal
 ○ Azim One
 ○ Robinson
 □ RSS
 ■ Night
 □ cities
 [Ok] [Cancel]

ISS
 Sat name and next event time unless in DX pane
 Tap Sat location or name to see Pass.
 Ground track for one future orbit
 DE antipode
 Concentric circles show where Sat is on horizon, 30° and 60° elevation

Azimuthal projection centered on DE

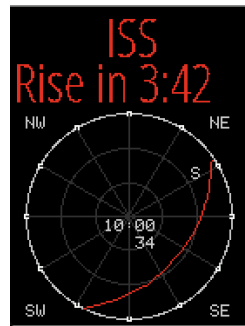
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The **DE** panel shows HamClock's idea of your location and local time. HamClock uses this location for many purposes from lunar angles to spot bearings. In this default configuration it shows local time and date, latitude and longitude, grid square and sun rise and set events. Tap **DE**: to select other formats or select **Data Panes** (listed starting on page 6) that can overlay this and the DX panel. Tap location to edit lat, long or grid, see page 10. Tap **R** or **S** to toggle showing the time **at** which the next or previous events occur, or the interval **in** which they will or have occurred. Tap the timezone offset to update if necessary; see page 11 for more about how HamClock manages time.



The **DX** panel shows HamClock's definition of a second location independent from DE. Similar to the DE panel, it shows the local time and date at the location, its latitude and longitude, grid square and sun times. Tap the timezone offset to update if necessary; no allowance is attempted for savings time. Tap **R** or **S** to toggle showing the time **at** which the next or previous events occur; the interval **in** which they will or have occurred; or the country prefix at the DX location. The bottom line shows the distance and bearing from DE to DX. Tap **LP** or **SP** to toggle whether this refers to short path or long path. Tap **DX**: to show a list of earth satellites. If a satellite has been selected, this panel changes to display its next pass; see next.



The **DX** panel can be repurposed to show details of the next satellite pass as viewed from DE. Below the satellite name is the time until the next Rise or Set event. Both events are based on the satellite passing above or below the ideal geometric horizon without regard to refraction. The format will be **HHhMM** if the event is more than an hour away otherwise **MM:SS**. A schematic representation shows how the pass will appear in the sky above DE oriented as shown by the compass directions in each corner. Faint lines are drawn at 30° and 60° elevation and every 30° in azimuth. The setting end of the pass is marked with an **S**. Midway along the pass are shown the **duration** as MM:SS and **maximum elevation** in degrees. Tap anywhere in the circle for a menu of additional options.

- Below are descriptions of the tall narrow pane in the upper right corner of HamClock.
- Tap near the top for a menu of available choices; choose one, or more will cycle.
- Some choices also use lower tap positions for specific functions as described below.

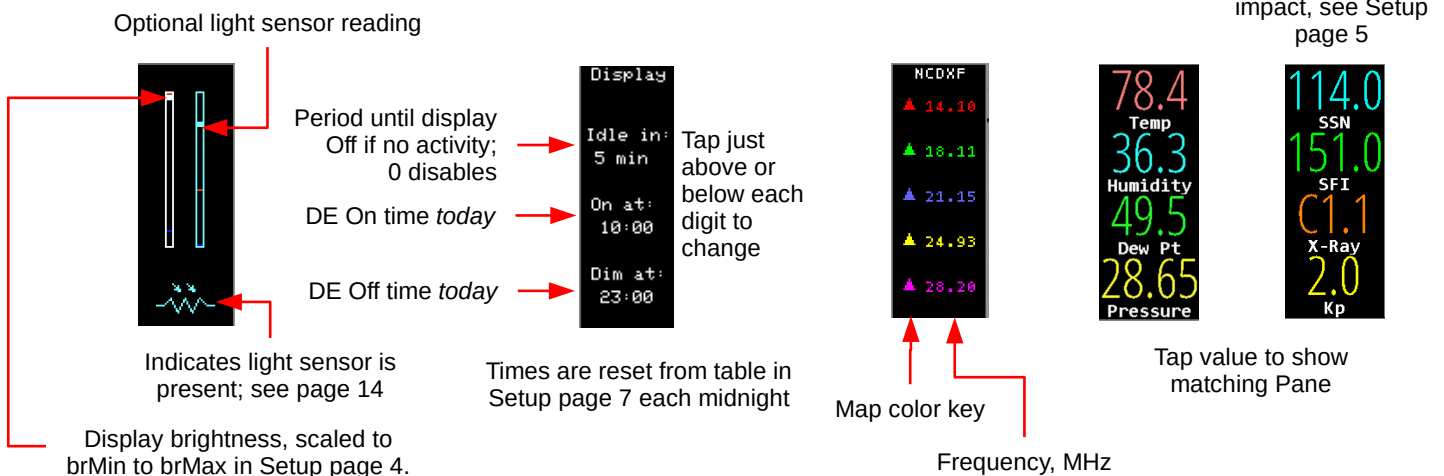
Display Brightness Control (see page 11)

Display On/Off Timer (see page 11)

NCDXF Beacons

BME Env stats

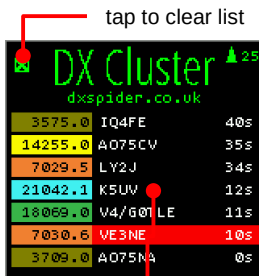
Space Wx stats



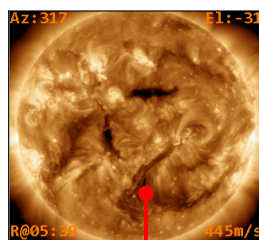
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Data panes

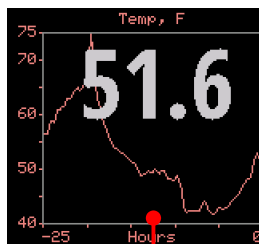
- Tap the top center of a pane for a menu of available choices; choose one, or more will cycle.
- Choices may be assigned to one pane at a time, and most panes must be assigned at least one choice.
- Some choices also use lower tap positions for specific functions as described below.



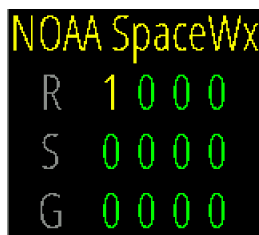
* **DX Cluster** displays and maps spots from the cluster host defined in Setup page 2, subject to any filters and watch list engaged there. See page 8 for more information on setting up a cluster. Listing direction may be set in Setup page 5. Rows are colored by band as per Setup page 6. Rows matching the watch list are colored red. The host is shown in yellow while connecting, green while functional or red if there is an error. The columns are kHz, call and age. Tap any row to set DX and rotator (page 7) and radio (page 8) if configured. The list may be cleared by tapping ☒. Note: the DX Cluster pane may not mixed with other choices in any pane.



SDO shows current images from the Solar Dynamics Observatory satellite. The corners show current information with respect to an observer located at DE including the Azimuth, Elevation, time of next Rise or Set, and radial velocity where positive values indicate the motion is away from the observer. Tap near the center of the image to display a menu allowing any one of several image types to be selected; select **Rotate** to automatically cycle them all in turn; show a **Grayline** planning tool where DE and DX share twilight whenever either of their rise/set lines are close together; or display a recent solar **Movie** in a separate browser window.



If an optional **BME280** environmental sensor is installed and working (see page 11), then several pane options are available whose names begin with **ENV** to display temperature, humidity, dew point or station pressure. The current value is shown along with a 24 hour history. Tapping near the bottom of the pane will cycle immediately to another ENV choice without having to use the normal menu. If two sensors are installed, the pane is split to show graphs from each, labeled with their respective I2C bus addresses.



Space Wx shows the three main NOAA space weather scales. The left column is for the current conditions, and columns to the right are predictions for each of the next three days. All scales use the same range of values, zero through five, with larger numbers to indicate greater severity and public impact.

- R:** Radio blackout
- S:** Solar radiation storm
- G:** Geomagnetic storm

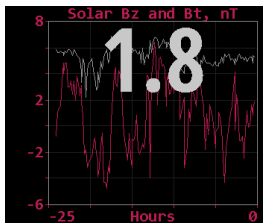


* **Contests** lists amateur radio contests for the upcoming, or current, weekend. Tap a contest to choose whether to include the contest times in the list; set the one-time alarm to the contest start time; display contest times in UTC or the DE timezone; and display a web page for the specific contest. Data are kindly provided with permission by Bruce Horn, WA7BNM.

* These choices may be displayed in a taller pane made from combined DE: and DX: panels (see page 5)

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Data panes, continued



Bz Bt shows the strength of the interplanetary magnetic field near Earth in units of nano Tesla. B_z is the strength of the field pointing north, the same direction as the Earth's field. B_t is the total vector sum in all directions, and thus is always the larger value. When B_z is negative, the fields are in opposite directions, partially cancelling the net shielding effect of the magnetosphere and negatively impacting HF propagation. Values of $B_z < -10$ can be significant.

POTA ▲ 33
40

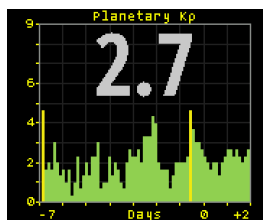
21074	AA0A	K-4487	2m
14074	KJ7JJ	K-5913	1m
14212	N3GE	K-8941	1m
21058	M0TTQ	G-0022	1m
14074	KE7BJ	K-4403	1m
14068	W8MND	K-8195	1m
7275	K4TCT	K-3845	1m

* **POTA** and * **SOTA** have separate panes for displaying a list of their current spots. Below the title is the total count of spots in the list. The table columns are kHz, call, location code and age. Rows may be filtered using the **S/P/A watch** list (see page 2). Frequencies are colored by band as per Setup page 6. Tap the count to select the column by which the table is sorted. SOTA only has room for one text position for age so any spots older than 9 minutes are marked with a plus +. Tap a spot row to set DX and control radio (page 10) and rotator (page 8) if used. Spot locations are plotted but paths are not because the spotter location is not available.

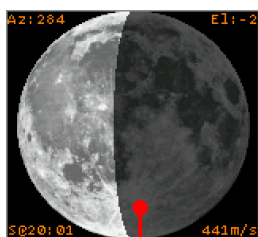
tap to set DX



DE Wx and **DX Wx** show the current weather at DE or DX from OpenWeatherMap.org. If the location is not changed for at least an hour, an up or down arrow may appear to indicate the pressure trend direction. When either DE or DX is changed by any means the left pane will temporarily show its weather, unless already selected on another pane.



Planetary K shows the Kp index now, with a graph extending from 7 days prior to 2 days forecast.



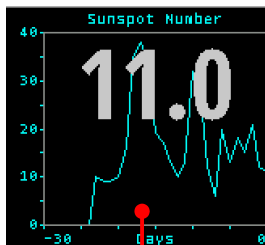
Moon displays a graphic of the lunar surface facing earth with the proper portion shown in shadow. The corners show information with respect to an observer located at DE including the Azimuth, Elevation, time of next Rise or Set, and radial velocity where positive values indicate the motion is away from the observer. Tap the lower half for a menu to display a full rotation movie or display the EME planning tool (see page 13).

tap to show EME planning tool

* These choices may be displayed in a taller pane made from combined DE: and DX: panels (see page 5)

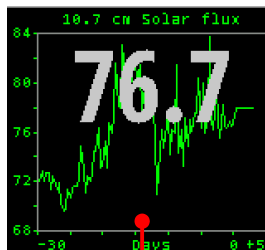
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Data panes, continued



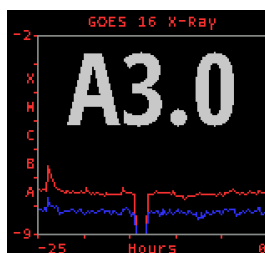
Sunspot N shows the current SIDC sunspot number and 30 days history. Since one solar revolution is approximately this period and solar features typically evolve fairly slowly, the graph provides a crude prediction of solar activity for the next month. Tap in the lower half to show a longer history.

tap to show historical values

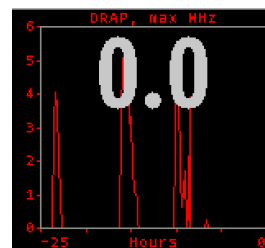


Solar Flux shows the current 10.7 cm measurement from National Research Council Canada, as well as a 30 day history and prediction for the next three days. Tap in the lower half to show a longer history.

tap to show historical values



X-Ray shows the current solar X-Ray levels and flare classification as measured by the GOES-16 satellite with a 24 hour history. The levels are the powers of a logarithmic scale computed as $\log_{10} (W m^{-2})$. The blue line is the 0.05 - 0.4 nm band, red is the 0.1 - 0.8 nm band.



The **DRAP** plot option shows the highest frequency that is attenuated by at least 1 db anywhere on Earth over the past 24 hours. Although the plot does not indicate the location where this occurred, it is usually centered on the Earth daylight side unless there is a Polar Cap Absorption event in progress. Also see the DRAP map option on page 12. The signal paths are for an angle of incidence, α , of 90 degrees (straight up). For shallower angles, multiply the attenuation by $1/\sin(\alpha)$.

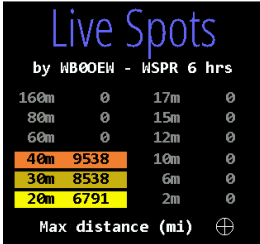


Rotator control: If `rotctld` is set in Setup page 3 then a Rotator option is available as a pane choice to control most rotators supported by hamlib. Set the *host* and *port* fields to the address of rotctld on your network. *You must get rotctld working on your system first, then consider controlling it from HamClock.* The **Az** row shows the rotator azimuth reported by rotctld and an angle graphic. Tap the arrows beneath to manually command left and right rotations of 5 and 20 degrees, with the current commanded position shown between in a smaller font. An azimuth beam will also be shown on the main map. If the rotator includes an elevation axis a second row, labeled **El**, provides similar functions.

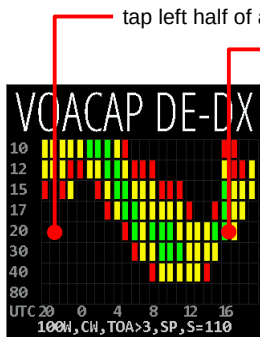
Tapping **Auto** will either track the current satellite, if one is set and there is an elevation axis, or keep azimuth pointing toward the short path of the current DX location. If the elevation axis can rotate beyond vertical to 180 degrees, *i.e.*, upside down, it will be used to avoid an azimuth wrap during tracking and will be indicated with a red arrow arc on the El row. All motion will cease while the **Stop** button is active or the Rotator pane is not visible. Sat tracking requires HamClock to be set to UTC (see page 9).

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Data panes, continued



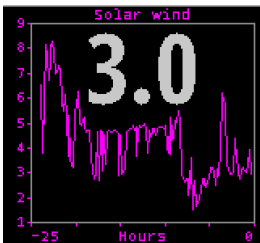
Live Spots shows personalized reports from WSPRnet.org, PSKReporter.info or ReverseBeacon.net. With WSPR and PSK you may choose spots posted **by** your own DE **call** or from your **grid**; or spots which others post **of** your DE **call** or **grid**. Using your grid allows you to explore propagation from your general location without transmitting. Note RBN only works with skimmer spots **of** your call (not **by**) because grids of the spotted transmitter stations are not available. Tap the band table to display a menu that controls these choices as well as maximum age; whether to list count or distance to farthest spot; and which bands to map. Paths show a circle ● at the TX end, a square ■ at the RX end and the farthest path for each band is marked with a target ⊕ and optionally labeled. Placing the cursor over either end will show the cursor info table (see page 12).



tap to change time zone, power, mode, TOA, SP/LP

tap left half of a row to show band reliability map
tap right of a row to show band TOA map

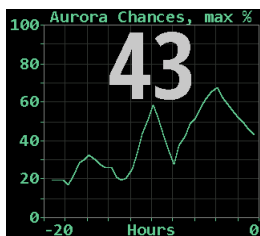
VOACAP: This pane choice shows a graph of path percentage reliability predictions from DE to DX spanning 24 hours for each HF ham band. Graph squares are black if reliability is less than 10%; red if less than 33%; yellow if less than 66% and green if above 66%. Predictions always use VOACAP configured for isotropic 0 dBi antennas on both ends; quiet location noise (-153 db) and the current mean sunspot number. Additional VOACAP parameters are variable and may be set by tapping the fields across the bottom: transmit power, mode, Take-Off-Angle at DE and SP/LP to select Short or Long path. The graph time axis always places now at the left edge. Tap the timeline to toggle labels in UTC or DE local time. Tapping the left half of a band row will show a world map of path reliability from DE, using the same color code. Tapping the right half of a band row will show a map of TOA from DE using the path with the best reliability. Tap either again to restore the normal background map.



Solar wind: This pane shows 24 hours history of solar wind activity. Solar wind is a good predictor of geomagnetic disturbances such as auroral activity and unusual polar HF propagation. The available real-time metrics are density, in protons cm^{-3} , and speed, in km s^{-1} . The product of these values gives the flux rate, or number of protons flowing through a unit square per unit time, which is often a better predictor than either value alone. HamClock displays this product in units of $10^{12} \text{ protons m}^{-2} \text{ s}^{-1}$ for which values above five or so suggest better chances for aurora.

Frequency	Call Sign	Age
10137.4	WGRBF	2.7y
10137.5	N4NX	135d
10137.5	N4NX	135d
10137.5	N4NX	135d
10137.5	NY4Q	135d
10137.5	NY4Q	135d
10137.5	K4SHA	135d

* **ADIF:** This pane lists and maps up to the 1000 newest QSOs in the ADIF file named in Setup page 3. Entries are sorted by age and may be scrolled using the arrows. Rows are filtered using the **SIPIA** watch list (see page 2). Frequencies are colored by band as per Setup page 6. The file is reread every 30 seconds for automatic monitoring or whenever the file name is tapped. Tapping a row sets the DX object. Each ADIF record must define the fields CALL or CONTACTED_OP; QSO_DATE; TIME_ON; BAND or FREQ; MODE; GRIDSQUARE or LAT and LON. All others are silently discarded. Optional fields STATION_CALLSIGN, OPERATOR, MY_GRIDSQUARE, MY_LAT and MY_LON are filled from DE if absent.

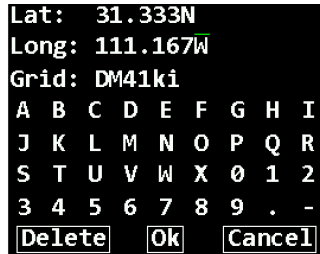


Aurora shows the current and recent maximum percent chances of visible activity anywhere on Earth. To see the current best location, change to the Aurora map style (page 12). Active auroral regions can absorb HF but act as reflecting layers at VHF.

* These choices may be displayed in a taller pane made from combined DE: and DX: panels (see page 5)

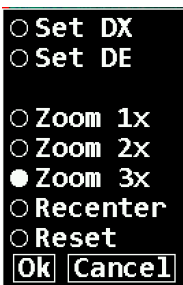
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Notes



Setting DE and DX: Tapping lat, long or grid in the DE: or DX: panes will display a dialog where these values may be directly edited to full precision either by tapping the virtual keyboard or using a real keyboard the same way as Setup. Corresponding values will be computed automatically and invalid entries will be flagged when clicking Ok. Grid coordinates are based on the SW corner.

HamClock always uses full precision internally but, due to limited screen space, rounds the display to whole values. This may lead to unexpected results when entering fractional lat or long values. For example, suppose they are set to 35N and 110.1W so the grid will be DM45ka. The main display will show 35N 110W grid DM45 which, unless one knows the internal values, seems incorrect because 35N 110W exactly is actually in grid DM55. When in doubt, open the dialog to review the values at full precision.



Tapping anywhere on the map brings up a multi-purpose popup menu. It always offers controls to set the HamClock **DE** or **DX** object to the tapped location if desired. It may also offer controls to set a specific **Zoom** factor and/or to **Recenter** the map at the tapped location, depending on the current map projection. The Mercator projection implements all options although recentering may not extend beyond the poles. Robinson can only shift the center longitude, it can not zoom. The other projections can neither zoom nor recenter. The menu starts with the current zoom factor preselected. **Reset** restores the map to full size centered on the longitude specified in Setup page 4. **DX** can also be set immediately without using the menu by either tapping mouse Button 2 (middle) alone, or Button 1 (left) in combination with the Control or Meta keys (name varies depending on your keyboard).



Scroll controls appear automatically when panes have too many lines to display. *Up* shows how many more lines are above, *down* shows the number below. Tapping either arrow scrolls to reveal the next group of lines in the respective direction, retaining one for context. Setup page 5 allows setting whether the list grows top-down or bottom-up and the number of unseen lines.

Rig control: Setup page 3 allows choosing *rotctld* or *flrig* so that tapping a DX Cluster or POTA/SOTA spot will send the frequency to your radio VFO A. Set the *host* and *port* fields to the address of the program on your network. Get it working on your system first, then consider controlling it with HamClock. HamClock can also control a KX3 using a RPi IO pin, see page 14.

DX Cluster: DX cluster control is on Setup page 2. Only Spider and AR clusters are currently supported. Filtered and/or watched spots will be listed in the DX Cluster pane as they arrive (see page 6) and displayed on the map according to *Spot labels* and *paths* options in Setup page 5. If the path is plotted, the TX end is marked with a circle ● and the RX end with a square ■. If the cursor moves over either end, additional information is shown in the cursor info table (see page 12). Tapping an entry in the list will redefine HamClock's DX to that location and may also tune your radio (see page 10) or command your rotator (see page 8). If you make multiple simultaneous connections to the same cluster, be sure they each use a unique login SSID suffix.

Toggling **WSJT-X?** to Yes will instead connect to WSJT-X (or compatible) on your local network. When set up properly, each time you reply to an FT8 contact, the station will appear in the HamClock DX Cluster pane list. Tapping an entry works the same as described above. Note only FT8 messages that include both station's grid squares are listed. Configure HamClock by opening the WSJT-X *Reporting* preferences tab. If you want applications running on more than one computer to receive WSJT-X reports then set *UDP Server* to either a multicast address (example 224.0.2.0) or the broadcast address for your network (example 192.168.1.255). If all applications are on the same computer, you can use 127.0.0.1. Then configure each application, including HamClock, to match. In all cases, leave the *UDP Server port number* set to the default of 2237.

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Notes, continued

Time: The time shown in large white letters below your call always shows HamClock's idea of UTC. If your DE time is incorrect, tap the timezone offset button and adjust it using the popup menu provided. The times shown in the DE and DX panes are initialized to best-effort estimates of local standard time at these locations with respect to HamClock's UTC. If the UTC button is black-letters-on-white-background then HamClock is using real UTC. But you may modify the time by tapping on various locations (see page 4). This can be useful, for example, to show a satellite location, gray line or VOACAP prediction at some moment in the past or future. Changing away from UTC causes the UTC button to flash red **OFF** as a stark reminder the HamClock is no longer tracking real UTC. Tapping the red button will return abruptly back to real UTC. A large question mark is shown when time is unknown. Note well:

- Do not set the large white time to your DE time or adjust it to correct DE time, use the timezone button.
- HamClock makes no attempt to automatically account for savings time, you must do so manually.

Stopwatch: Tap the stopwatch icon (beneath UTC seconds) to enter. Displays elapsed time in HH:MM:SS.SS. Tapping **Run** begins or resumes counting; **Stop** freezes display and counting; **Lap** freezes display but continues counting; **Reset** starts over; tap along the spectrum bar to adjust color; **Exit** returns to main HamClock screen.

Independent 24 hour **daily** and **once-only** alarms are available. The daily alarm always uses the DE timezone, the once-only alarm may use DE or UTC. When either is *armed*, the alarm clock icon on the HamClock main screen will be green (instead of gray) and the alarm time may be shown in Big Clock. When either alarm goes off it will be announced on the main screen in the center pane; on the Stopwatch screen by highlighting its control button; and on Big Clock by highlighting the alarm time. Tapping any of these will cancel the alarm; these alerts automatically time out after 60 seconds. See page 15 for hardware control.

Count down counts backwards from the value set at its right, tap just above or below to increase or decrease down to 1 minute. If counting down is active: the main HamClock screen shows the time remaining in lieu of the stopwatch icon; Countdown may be chosen as a Pane option; and the value may be shown in Big Clock. It may be restarted from any of these locations with a tap. Hold the main icon for 3 seconds to enter the Stopwatch screen. See page 15 for hardware control.

Big Clock shows a large dedicated clock. Tap anywhere for a menu to control options including analog or digital format, UTC or DE, 12 or 24 hour, date info, DE or space weather, seconds, and basic control over alarm and count down.



Brightness and Light sensor controls: If a light sensor is installed (aka “photo resistor” for historical reasons) and the *Full scrn direct?* option in Setup page 5 is Yes, then the right-most pane may be set to show two vertical scales. The left shows the current display brightness and the right the current light sensor reading. Both include their respective calibration markers. Brightness is scaled from, and limited to, **Min%** to **Max%** from Setup page 4. If the display can only be turned on or off, the brightness scale will only show a marker at top or bottom. To calibrate a desired brightness response, start by exposing the light sensor to a bright intensity then tap in the upper half of the left scale to set the desired display brightness at that intensity (or just “on”). Then expose the sensor to a dim light and tap in the lower half to set the desired brightness at that low intensity (or “off”). Systems without a light sensor but with ability to control display brightness will provide a single slider to control display brightness manually.

On/Off timers: The right-most pane may provide a table of DE clock **On** and **Off** times at which the display will be set to Max% or Min%, respectively; set the times equal to disable both timers. **Idle** sets the number of minutes of no user activity after which the display will change to Min%; set to zero to disable. Changing the On or Off times will also set the On/Off table in Setup page 7 to match for the current day. Conversely, the pane's values will be reset from this table at each local midnight. If these timers turn the display Off, the light sensor will then **not** control display brightness again until either a timer commands the display back On or the user taps anywhere in HamClock to restore brightness.

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Notes, continued

Lat	9N	NL7D
Lng	67W	DM42
Grid	FJ68	ZL1GSM
LMT	23:57	RF73
CQ	9	FT8
ITU	12	kHz 28075
Pfx	yy	Age 38m
SP	110°	SP 231°
	3221 mi	6794 mi

Cursor info table: A box such as those shown at left will appear automatically in the upper left corner of the map whenever the cursor is over the map or a spot symbol. The contents change depending on context but may contain Latitude; Longitude; Grid; Local Mean Time (does not account for savings time); CQ and ITU zone designations; Prefix; TX and RX call and grid; Mode; Frequency; spot Age; Bearing and Distance from DE; and weather conditions. The bearing degree symbol becomes M if referenced to magnetic north (see Setup page 5). When displaying spot information the border color matches the assigned band color. The box disappears if idle for 30 seconds.

Style:
<input type="radio"/> Countries
<input type="radio"/> Terrain
<input type="radio"/> DRAP
<input type="radio"/> MUF-VOACAP
<input checked="" type="radio"/> MUF-RT
<input type="radio"/> Aurora
<input type="radio"/> Weather
Grid:
<input checked="" type="radio"/> None
<input type="radio"/> Tropics
<input type="radio"/> Lat/Long
<input type="radio"/> Maidenhead
<input type="radio"/> Azimuthal
<input type="radio"/> CQ Zones
<input type="radio"/> ITU Zones
Projection:
<input checked="" type="radio"/> Mercator
<input type="radio"/> Azimuthal
<input type="radio"/> Azim One
<input type="radio"/> Robinson
<input type="checkbox"/> RSS
<input type="checkbox"/> Night
<input type="checkbox"/> Cities
<input type="button" value="OK"/> <input type="button" value="Cancel"/>

Tap the upper left map corner for a menu of viewing options:

• **Style** selects the overall map background from the following choices:

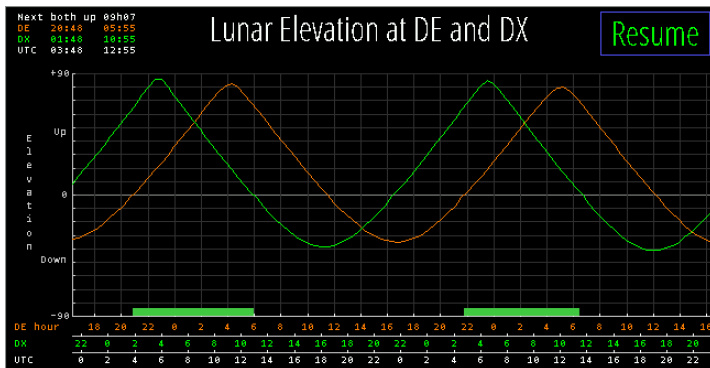
- political **Countries** and natural **Terrain**
- **DRAP:** This map style shows a near real-time display of the NOAA *D Region Absorption Predictions* model, or DRAP. The model predicts HF propagation absorption caused by solar X-ray and proton flux events. D layer absorption decreases with increasing frequency, so the map color-codes the highest frequency ray that is attenuated by at least 1 dB while passing through each location. Rays at lower frequencies will experience progressively greater attenuation of 30 dB or more. The color scale is gray for no absorption at any frequency progressing through a spectrum to indicate higher frequencies. See also the DRAP pane (page 8) for a time history.
- **MUF-VOACAP:** This map style shows the VOACAP model for median Maximum Usable Frequency between DE and other points in the world about half the time each month. This model is useful for long term planning, such as for a DXpedition; the MUF-RT style is a better indication of current conditions. Note even when a path seems promising, it may still not be unusable due to low signal power, local noise or variable space weather conditions. The map is color coded the same as DRAP.
- **MUF-RT:** This style shows a real-time map of Maximum Usable Frequency based on a worldwide consortium of ionosondes, those of which were active within in the last hour are labeled with their reporting frequency. The data are updated every fifteen minutes. Note that since the stations are not spaced uniformly, significant license was required to perform global interpolation. At any given location, the MUF value is the highest frequency that will refract back

to Earth a wave launched 1500 miles away, thereby supporting a total single hop path of 3000 miles. Waves higher in frequency will generally continue on to space and be lost. Using this basic model, one can imagine where the hops will occur along a path from DE to DX and estimate whether they will be supported for a given band. Note even when a path seems promising, it may still not be unusable due to low signal power or local noise. This map is a good indication of current conditions; the MUF-VOACAP style is better suited for long term planning such as for a DXpedition. Both use the same color key. Data for this map, and permission to use, are kindly provided by KC2G.

- **Aurora:** This map style shows the chances for aurora activity based on total ionospheric energy deposition. High activity is often associated with geomagnetic storm conditions. This map is best viewed with the Azimuthal projection.
- **Weather:** shows color-coded temperature, pressure isobars and wind speed direction flags; updated hourly.
- **Grid overlay:**
 - **Tropics** draws global lines at ± 23.5 degrees latitude
 - **Lat/Long** draws lines of constant latitude and longitude every 15 degrees
 - **Maidenhead** draws (and labels in Mercator projection) each top-level grid square
 - **Azimuthal** draws radial lines every 15 degrees of bearing and rings at constant distance from DE
 - **CQ** or **ITU zones** draws the boundaries of these global regions
- **Map Projection:**
 - **Mercator** is the classic form with equally spaced lines of latitude and longitude; large distortion near poles.
 - **Azimuthal** shows front and back hemisphere views centered on DE and its antipode, respectively.
 - **Azim One** is one full globe centered on DE; the entire outer edge is the single antipode point.
 - **Robinson** is the popular projection often used in publishing; pleasing but has distortion everywhere.
- **RSS:** overlays the lower map with live RSS feeds, cycling every 15 seconds. Tap to show parent web page.
- **Night:** select to darken the map where it is currently night time; good for showing current gray line boundary.
- **Cities:** whether to display name and population of representative cities nearest to cursor, if any.

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Notes, continued



The **EME planning tool** is shown by tapping in the lower half of the Moon pane (see page 7). The tool plots the lunar elevation at DE and DX for the next two days starting now. The time axis is labeled in DE and DX local time and UTC. The table in upper left shows the next period when the moon is simultaneously up at both DE and DX. All such periods are also marked along the time line. Tap the plot anywhere for detailed information at that moment. Tap Resume to restore normal HamClock operation or let it time out.



Demo mode: Tap the padlock to select this mode which means HamClock will autonomously make a random setting change to itself every 30 seconds, including the plot panes, DX location and map view options. When active, the padlock changes to a running figure to indicate demo mode is active. Meanwhile HamClock may still be used normally. Tap the figure again to turn off demo mode. Note that whether Demo mode is chosen is not persistent, it must be selected again if desired each time HamClock starts.

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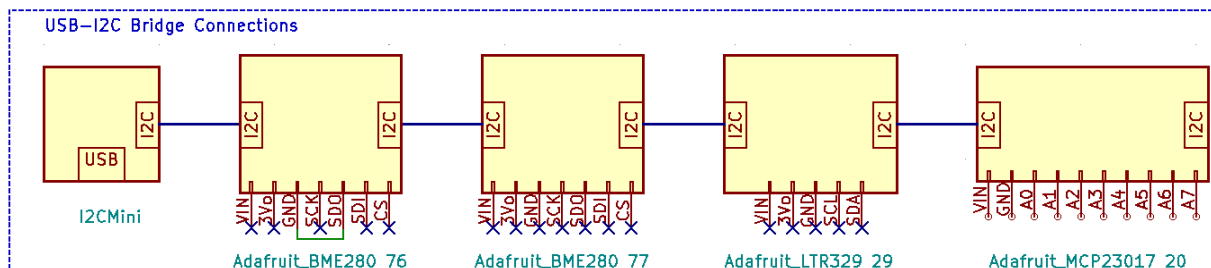
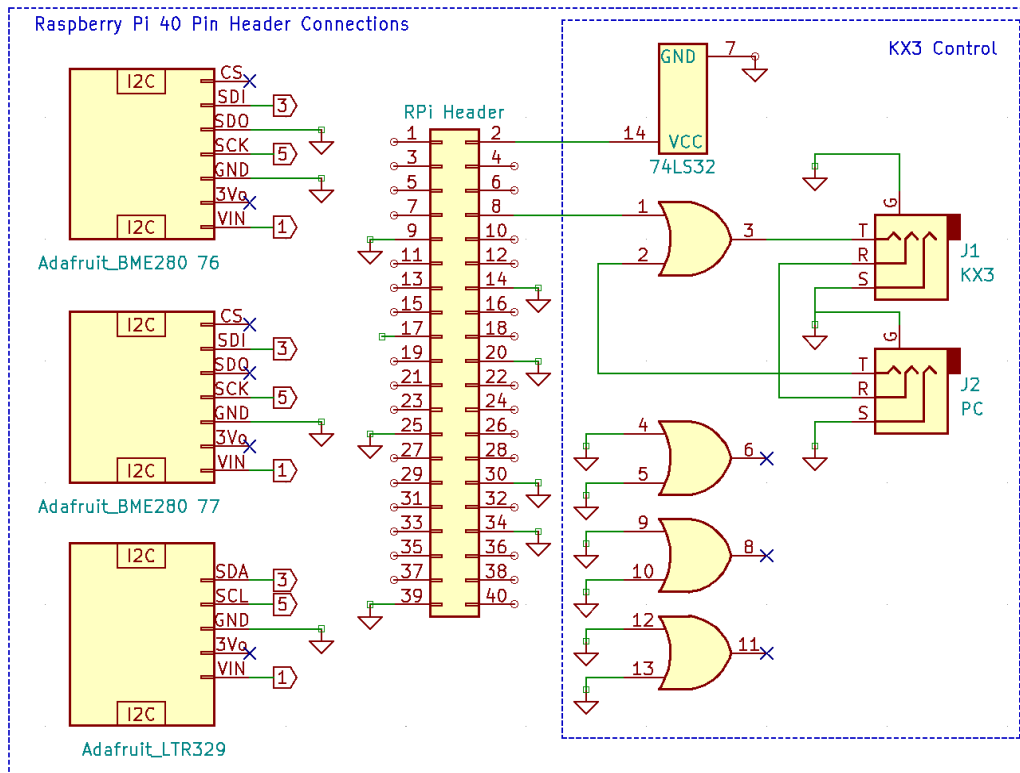
External IO Options

HamClock supports several optional external devices to enhance the operator experience. These include

- one or two BME280 environmental sensors for temperature, pressure and humidity;
- LTR329 light sensor for automatic dimming depending on ambient lighting (see page 11);
- several switches and LEDs to complement the ON AIR indicator, timer, alarm clock and satellite status;
- Elecraft KX3 serial control, available only with RPi header pin 8.

These devices may be connected to HamClock in two different configurations, as shown below. Devices may be connected in any order and all are optional.

- to the 40 pin header of a Raspberry Pi
- to any linux or Mac with a USB port using an I2CMini from i2cdriver.com, including the Pi if preferred



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External IO Options, continued

The discrete GPIO options are described in the table below. Each is independent and may be chosen separately as desired. Connect the Terminal connections to either the Pi header or the MCP23017 port expander, depending on the HamClock configuration used on page 14. The MCP23017 is not needed if none of these are used.

On a Raspberry Pi, Setup page 4 also includes a toggle named **GPIO**. Setting this Off prevents HamClock from using any of the native pins in order that they may be used for something else. To use the I2C header pins on a RPi the **GPIO** toggle must be set to Active *in addition to* setting the proper file name (see next).

GPIO Option	Description	Terminal	Pi Header Pin	MCP23017 Pin
	A falling edge from a SPST switch or PTT line on terminal CD_4 (re)starts the count down timer. Driving voltage, if any, must not exceed 3.3 V. The LEDs indicate the time remaining: green when counting down; both when 1 minute or less remains; red when timed out.	CD_1 CD_2 CD_3 CD_4	17 33 35 37	VIN A0 A1 A2
	Output terminal SA_A indicates satellite visibility from DE. Normally low, it cycles high at 1 Hz for 1 minute before rise, stays high during the pass, cycles at 2 Hz during the last minute then stays low again after set.	SA_1	38	A5
	Grounding input terminal OA_1 with a switch or PTT line will change the call sign text to "ON THE AIR". Driving voltage, if any, must not exceed 3.3 V.	OA_1	40	A6
	Output terminal AL_1 will go high while either alarm is "ringing". The schematic shows an LED but a piezo buzzer works also. Briefly grounding input terminal AL_2 will silence either alarm.	AL_1 AL_2	31 29	A3 A4

This flexibility does come at a price. You must determine and enter the name assigned by the host to the native or bridged I2C bus in the **I2C file** field of Setup page 4. The table below shows a sample of systems and *typical* names. One way to discover the *exact* name is to start a terminal session and run the command `ls /dev`. Look for something similar or, in the case of a USB-I2C bridge, remove and plug the device back in and see what changes. If you find both **tty** and **cu** names that are otherwise the same, always use the cu name.

Configuration	Typical I2C File name
Raspberry Pi 40 pin header	Debian /dev/i2c-1 FreeBSD /dev/iic0
USB-I2C bridge	Debian /dev/ttyUSB0 FreeBSD /dev/cuaU0 macOS /dev/cu.usbserial-DK0C3XGZ

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Program Options

On UNIX-like systems the hamclock command line program accepts the following optional arguments. As a purely pedagogical example: to skip the initial setup screens (assuming all fields are valid) to immediately begin normal operation, change the read/write web interface to port 20000, and throttle the CPU load to 20%, run hamclock as:

```
hamclock -k -w 20000 -t 20
```

```
-0 : remove eeprom file to restore all default values
-d d : set working directory to d; default is /Users/ecdowney/.hamclock/
-e p : set RESTful web server port to p or -1 to disable; default is 8080
-f o : force display full screen initially to "on" or "off"
-g : init DE using geolocation with current public IP; requires -k
-h : print this help summary then exit
-i i : init DE using geolocation with IP i; requires -k
-k : start in normal mode, ie, don't offer Setup or wait for Skips
-l l : set Mercator or Robinson center longitude to l degrees, +E; requires -k
-m : enable demo mode
-o : write diagnostic log to stdout instead of in /Users/ecdowney/.hamclock/
-p f : require passwords in file f formatted as lines of "category password"
      categories: changeUTC exit newde newdx reboot restart setup shutdown unlock upgrade
-r p : set read-only live web server port to p or -1 to disable; default 8082
-s d : start time as if UTC now is d formatted as YYYY-MM-DDTHH:MM:SS
-t p : throttle max cpu to p percent; default is 80
-v : show version info then exit
-w p : set read-write live web server port to p or -1 to disable; default 8081
-x n : set n max live web connections; max 100; default 10
-y : activate keyboard cursor control arrows/hjkl/Return -- beware stuck keys!
```